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# 328651(28)

APR-MAY2022

## B. E. (Sixth Semester) Examination ~~2020~~

**(New Scheme)**

**(Et & T Engg. Br.)**

**DIGITAL SIGNAL PROCESSING**

***Time Allowed : Three hours***

***Maximum Marks : 80***

***Minimum Pass Marks : 28***

***Note :*** *Attempt all questions. Part (a) of each question is compulsory. Attempt any* ***two*** *parts from (b), (c) and (d) of each question.*

### Unit - I

**1.** (a) Name any two properties of DFT. 2

(b) Compute circular periodic convolution of the two

sequences $x_1(n) = \{1, 1, \underset{\uparrow}{2}, 2\}$ and $x_2(n) = \{1, 2, 3, 4\}$. 7

(c) Derive the DFT of the sample data sequence $x(n) = \{1, 1, 2, 2, 3, 3\}$ and compute the corresponding amplitude and phase spectrum. 7

(d) Given $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$, find $X(n)$ using DIT-FFT algorithm. 7

## Unit - II

2. (a) Define Canonic and non-canonic structure. 2

(b) Determine the direct form I and II realisation for a third order IIR transfer function :

$$H(z) = \frac{0{\cdot}28z^2 + 0{\cdot}319z + 0{\cdot}04}{0{\cdot}5z^3 + 0{\cdot}3z^2 + 0{\cdot}17z - 0{\cdot}2}$$ 7

(c) Determine the parallel realisation of the IIR digital filter transfer functions : 7

$$H(z) = \frac{3(2z^2 + 5z + 4)}{(2z+1)(z+2)}$$





(d) Develop cascade realisation structure for : 7

$$H(z) = \frac{\frac{2}{6} + \frac{5}{24} + \frac{5}{24}z^{-1} + \frac{1}{24}z^{-2}}{1 - \frac{1}{2}z^{-1} + \frac{1}{4}z^{-2}}$$

## Unit - III

3. (a) Define phase delay and group delay. 2

(b) Write short notes on Window Techniques by clearly illustration of the spectrum. 7

(c) A low pass filter is to be designed with the following derived frequency response :

$$H_d(e^{jw}) = \begin{cases} e^{-j2w}, & -\pi/4 \le w \le \pi/4 \\ 0, & \pi/4 < |w| \le \pi \end{cases}$$

Determine the filter coefficient $h_d(n)$ if the window function is defined as :

$$w(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$$

Also, determine the frequency response $H(e^{jw})$ of the designed filter. 7

(d) The desired response of a low-pass filter is :

$$H_d(e^{jw}) = \begin{cases} e^{-j3w}, & -3\pi/4 \le w \le 3\pi/4 \\ 0, & 3\pi/4 < |w| \le \pi \end{cases}$$

Determine $H(e^{jw})$ for $M = 7$ using a Hamming window. 7

## Unit - IV

4. (a) What are the requirements for converting a stable analog filter into a stable digital filter? 2

(b) Convert the analog filter into a digital filter whose system function is :

$$H(s) = \frac{s + 0{\cdot}2}{(s + 0{\cdot}2)^2 + 9}$$ 7

Use the impulse invariant technique, assume $T = 1$ s.

(c) Determine $H(z)$ for a Butterworth filter satisfying the following constraints :

$$\sqrt{0{\cdot}5} \le |H(e^{jw})| \le 1 \quad 0 \le w \le \pi/2$$
$$|H(e^{jw})| \le 0{\cdot}2 \quad 3\pi/4 \le w \le \pi$$





with T = 1s. Apply impulse invariant transformation. 7

(d) Design a digital Chebyshev filter to satisfy the constraints : 7

$$0{\cdot}707 \le |H(e^{jw})| \le 1, \quad 0 \le w \le 0{\cdot}2\pi$$
$$|H(e^{jw})| \le 0{\cdot}1, \quad 0{\cdot}5\pi \le w \le \pi$$

using bilinear transformation and assuming T = 1 s.

## Unit - V

5. (a) List the advantages of multirate signal processing. 2

(b) Obtain the expression for the output $y(n)$ in terms of $x(n)$ for the multirate system given as follow : 7

$$x(n) \rightarrow \boxed{\uparrow 5} \rightarrow \boxed{\downarrow 20} \rightarrow \boxed{\uparrow 4} \rightarrow y(n)$$

(c) Implement a two-stage decimator for the following specifications.

Sampling rate of the input signal = 20,000 Hz

M = 100

Passband = 0 to 40 Hz

Transition band = 40 to 50 Hz

Passband ripple = 0·01

Stop band ripple = 0·002 7

(d) For the given system with input $x(n)$, find the output $y(n)$. 7

$x(n) = \ldots\ldots\ldots\ x_{-4}\ x_{-3}\ x_{-2}\ x_{-1}\ x_0\ x_1\ x_2\ x_3\ x_4\ \ldots\ldots\ldots$